

Claims

1. A BDPD-based (Base-band Digital Pre-Distortion) method for improving efficiency of RF power amplifier, comprising:

5 (1) Determining structural parameters of a neural network as required and establishing the neural network, inputting modeling data and initial values of network parameters required for establishing the neural network model of the RF power amplifier;

10 (2) Propagating forward with the input data and network parameters, calculating the difference between output value of the neural network and the expected output value, then propagating backward along the neural network with said difference to correct the network parameters;

15 (3) Determining whether said difference meets the specified criterion; if so, outputting the neural network model of the RF power amplifier and going to step (4), otherwise inputting the corrected network parameters to the neural network and going to step (2);

20 (4) Solving the pre-distortion algorithm of the RF power amplifier with said neural network model;

 (5) Carrying out pre-distortion processing for input signal of the RF power amplifier with said pre-distortion algorithm and then feeding them to the RF power amplifier.

25 2. A BDPD-based method for improving efficiency of RF power amplifier according to claim 1, wherein said structural parameters comprise: the number n of delay items of input signal, the number r of neural elements on each layer of the neural network, the number m of layers of the neural network; said

modeling data comprises: output signal $Y(KT)$, input signal, and delay items of input signal of the power amplifier; said network parameters comprise: weight W_{ijk} and bias b_{ij} ; said output signal $Y(KT)$ of the RF power amplifier is the expected output value corresponding to the input signal, i.e., the actual output value of the RF power amplifier corresponding to the input signal.

5 3. A BDPD-based method for improving efficiency of RF power amplifier according to claim 2, wherein said input signal and
10 said delay items of the input signal are base-band digital signal amplitude $X(KT)$ of the power amplifier and delay items thereof $X[(K-1)T] \dots X[(K-n+1)T]$, respectively.

15 4. A BDPD-based method for improving efficiency of RF power amplifier according to claim 3, wherein the number n of delay items of input signal is: $1 < n < 10$, the number r of neural elements on each layer of the neural network is: $1 < r < 10$, the number m of layers of the neural network is: $1 < m < 10$.

20 5. A BDPD-based method for improving efficiency of RF power amplifier according to claim 2, wherein said input signal and said delay items of input signal are base-band digital signal amplitude $X(KT)$ of the power amplifier and delay items thereof $X[(K-1)T], X[(K-2)T], \dots, X[(K-n+1)T]$ as well as phase $\Phi_{in}(KT)$ of the base-band digital signal and delay items thereof $\Phi_{in}[(K-1)T], \Phi_{in}[(K-2)T], \dots, \Phi_{in}[(K-n+1)T]$; the number of delay
25 items of the input signal comprises the number n_1 of delay items of base-band digital signal amplitude and the number n_2 of delay items of base-band digital signal phase.

6. A BDPD-based method for improving efficiency of RF power

amplifier according to claim 5, wherein the number n_1 of delay items of base-band digital signal amplitude is: $1 < n_1 < 5$, the number n_2 of delay items of base-band digital signal phase is: $1 < n_2 < 10$, the number r of neural elements on each layer of the 5 neural network is: $1 < r < 10$, the number m of layers of the neural network is: $1 < m < 10$.

7. A BDPD-based method for improving efficiency of RF power amplifier according to claim 2, wherein said step (2) comprises:

(71) Calculating the corresponding intermediate variables 10 V_{ij} of the neural network with network parameters W_{ijk} of each layer of the neural network;

(72) Activating the function to calculate the output value Y_{ij} of each neural element in the corresponding neural network through the intermediate variables V_{ij} and the neural elements;

15 (73) Magnifying the output value of the neural elements on the last layer of the neural network for m times to obtain the output value $Y_m(kT)$ of the neural network, herein the value of M being higher than the saturation level of the power amplifier;

(74) Calculating the difference between $Y_m(kT)$ and actual 20 output $Y(kT)$ of the power amplifier;

(75) Magnifying the difference $e(kT)$ between $Y_m(kT)$ and $Y(kT)$ for $-m$ times and calculating $\Omega(V_{ij})$ with output value V_{ij} of the neural elements on the last layer of the network, herein,
 $\Omega(v) = d\Psi(v) / dv$;

25 (76) Multiplying $M_e(kT)$ with $\Omega(V_{ij})$ to obtain δ_{ij} ;

(77) Propagating δ_{ij} backward along the network channel,

in which propagating forward is carried out, with current values of network parameters and obtaining the intermediate variables $u_{i1}, u_{i2}, \dots, u_{ir}$;

(78) Calculating intermediate variables $\delta_{i1}, \delta_{i2}, \dots, \delta_{ir}$

5 with $u_{i1}, u_{i2}, \dots, u_{ir}$ and current network parameters;

Herein, $\delta_{i1}, \delta_{i2}, \dots, \delta_{ir}$ are obtained through multiplying $\Omega(V_{i1}), \Omega(V_{i2}), \dots, \Omega(V_{ir})$ with $u_{i1}, u_{i2}, \dots, u_{ir}$ respectively, said $\Omega(V_{i1}), \Omega(V_{i2}), \dots, \Omega(V_{ir})$ are calculated out with intermediate variable $v_{i1}, v_{i2}, \dots, v_{ir}$;

10 (79) Updating current network parameters with $\delta_{i1}, \delta_{i2}, \dots, \delta_{ir}$, and calculating c with the following equation: $c = [\sum(\delta_{i1}^2 + \delta_{i2}^2 + \dots + \delta_{ir}^2) + \delta_{ij}^2]^{1/2}$;

Wherein when updating the current network parameters, the updated network parameters W_{ijk} and b_{ij} are calculated out as 15 follows:

W_{ijk} = value of network parameter before update - $\eta \times \delta_{ij}$ x output value of corresponding neural elements, herein η is the searching step length;

b_{ij} = value of network parameter before update - $\eta \times \delta_{Ij}$;

20 8. A BDPD-based method for improving efficiency of RF power amplifier according to claim 7, wherein said step (3) comprises: determining whether c meets the criterion; if so, outputting the neural network model of the RF power amplifier, otherwise inputting the corrected network parameters W_{ijk} and b_{ij} to the 25 neural network and going to step (71).

9. A BDPD-based method for improving efficiency of RF power amplifier according to claim 7, wherein said $K = 2 \times$ mean gain

kb of RF power amplifier.

10. A BDPD-based method for improving efficiency of RF power amplifier according to claim 2, wherein the bandwidth of said input signal is wider than that of actual input signal of RF

5 power amplifier.